



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/748,359

12/30/2003

Valery M. Dubin

110348-135103

7770

25943

7590

08/08/2005

SCHWABE, WILLIAMSON & WYATT, P.C.
PACWEST CENTER, SUITE 1900
1211 SW FIFTH AVENUE
PORTLAND, OR 97204

EXAMINER

QUACH, TUAN N

ART UNIT

PAPER NUMBER

2826

DATE MAILED: 08/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/748,359	Applicant(s) DUBIN ET AL.	
	Examiner Tuan Quach	Art Unit 2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 May 2005.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) 9-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8 and 21-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

DETAILED ACTION

Rejection 35 U.S.C. 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 3, 5, 8 are rejected under 35 U.S.C. 102(b) as being anticipated by Marathe.

Marathe (6,476,498) teaches regarding claim 1, a semiconductor device comprising a substrate 216, a dielectric layer 212/210 over the substrate, a damascene interconnect structure 232/234/236 defined in the dielectric layer, a barrier layer 232 deposited over the dielectric layer and within the damascene interconnect structure, the barrier layer within the damascene interconnect structure being tapered. See column 5 lines 20-68, Fig. 3. Regarding claim 2, the barrier being thinner toward an edge and thicker toward the bottom is also shown, e.g., portion 231. Regarding claim 3, the via or trench is shown in the openings in dielectric layer. Regarding claim 5, the different barrier materials include well known refractory materials such as tantalum, tungsten, etc. Regarding claim 8, the use of low dielectric is also shown, e.g., column 6 line 52.

Rejection 35 U.S.C. 103

Art Unit: 2826

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Marathe et al. in view of Tu et al. or Aoyama et al.

The reference as applied above does not show the cap layer.

Tu et al. 6,566,250 teaches cap 20C over the copper plug. See column 5 line 45-60. Aoyama et al. 5,592,024 teaches the use of cap 7 over the interconnect for providing protection. See column 11 line 20 to column 12 line 22. It would have been obvious to one skilled in the art to have provided a capping layer to protect the interconnect as taught by Tu et al. or Aoyama et al.

Claim 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Marathe taken with Farrar.

Marathe is applied as above and does not recite all the materials in claim 5, thicknesses in claims 6 and 7, the silicon oxide in claim 8.

Farrar 2002/0024150 teaches the various barrier materials including refractory materials including the selection of appropriate materials, the appropriate thickness for the barrier, and the conventional dielectric material such as oxide. See [0051].

It would have been obvious to one skilled in the art to have employed the well known alternative barrier materials, to have selected and optimized the appropriate thickness and to have employed silicon oxide as dielectric material, as claimed in these claims since such correspond to well known materials and dimensions as evidenced by Farrar. Official notice is further given regarding well known alternative barrier materials not expressly recited.

Claims 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Marathe taken with Farrar and McCown et al.

Regarding claim 21, Farrar above is applied as above and further teaches conventional application of damascene interconnect for connecting to microprocessors including the bus 452, the microprocessors. See [0066] and Fig. 24.

Marathe above is applied as above regarding the damascene having tapered barrier.

It would have been obvious to one skilled in the art in practicing the Marathe invention to have applied into microprocessor interconnection since such is

Art Unit: 2826

conventional and advantageous applications as evidenced by Farrar. Conversely, it would have been obvious to have provided in Farrar the tapered barrier as taught by Marathe to obtain the advantages cited, column 5 lines 53-64. It would have been further obvious to provide the connection to a network interface since such is well known and obvious as evidenced by McCown et al., 2002/0184490, [0025], wherein microprocessor 200B communicates through device bus 202B and network interface 206B.

Regarding claim 23, these claims correspond to similar features in claim 3 above.

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Marathe taken with Farrar and McCown et al. as applied to claims 21-23 above and further in view of Tu et al. or Aoyama et al.

The reference as applied above does not show the cap layer.

Tu et al. 6,566,250 teaches cap 20C over the copper plug. See column 5 line 45-60. Aoyama et al. 5,592,024 teaches the use of cap 7 over the interconnect for providing protection. See column 11 line 20 to column 12 line 22. It would have been obvious to one skilled in the art to have provided a capping layer to protect the interconnect as taught by Tu et al. or Aoyama et al.

Applicant's arguments filed May 26, 2005 have been fully considered but they are not persuasive.

Applicant argues that the tapered barrier is not shown. Nonetheless this is clearly shown in Fig. 3, layer 232, wherein the increasing thickness toward the bottom and the decreasing thickness along the sidewall is clearly shown.

Applicant further argues that the thicker barrier toward the bottom in Marathe is to eliminate void and increase resistance to electromigration and increase mean time to failure whereas the tapered barrier in the claimed invention serves to improve gap fill, metal overhang or incomplete material deposition. Nonetheless, it remains apparent that an improved gap fill would result in eliminating void and wherein increased resistance to electromigration would follow.

Regarding the remaining references, applicant argues that the deficiencies of Marathe are not taught therein. The references however clearly establish the prima facie obviousness of the claimed inventions in the dependent claims thereover.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Tuan Quach whose telephone number is 571-272-1717. The examiner can normally be reached on M-F from 8:30 AM to 4:30 PM.

Art Unit: 2826

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor Nathan Flynn, can be reached on 571-272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Tuan Quach
Primary Examiner